RISKS, SAFETY AND INCLUSIVE TRAMS FROM A DISABILITY PERSPECTIVE – REPORT FROM A RESEARCH PROJECT

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Swedish Federation of People with Mobility Impairment (DHR) Gothenburg Division

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Gothenburg, June 2022

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FOREWORD

The work on this report took place in 2021–2022 (Kindberg & Larsson, 2022). It addresses not only risks, inaccessibility and barriers but also opportunities for making improvements and achieving greater usability for everyone in society. The report addresses an entire transport chain, i.e. the importance of being able to see the whole and the ways one can move from one's residence to the tram stop and then onward until the destination has been reached.

A number of people have been helpful and offered their views on our research, and we consequently wish to express our warm thanks to Astrid Steen, chairperson of the Association of Mobility Impaired Youth, Gothenburg Club, and to Jonas Andersson, office manager at The Swedish Federation of People with Mobility Impairment (DHR), Gothenburg division. Thanks to DHR Gothenburg division, who made the publication and English translation possible.

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The authors

1. INTRODUCTION

1.1 Origins of the project

The disability organisation *DHR – Delaktighet Handlingskraft Rörelsefrihet*, (*Participation, Actionability, Freedom of Movement*, The Swedish Federation of People with Mobility Impairment (DHR*)*), was formed in 1923 and has worked to promote greater accessibility, public communication, transport services, personal services and assistive devices in many ways throughout its history. The organisation has been known as *DHR – Delaktighet Handlingskraft Rörelsefrihet* since 2017. It has long advocated for the importance of an accessible society for all in its publications (Westlund, 2005; Wermeling, 2013).

This report addresses three important concepts – participation, accessibility, and usability. These three concepts are bound up with one another. Accessibility should always be investigated and studied together with the concept of usability. Focusing on usability puts the emphasis 'on the product or service, and not on the individual's lack of abilities in various respects. That which is usable for people with disabilities is presumably usable for most others as well' (Lindqvist & Lundälv, 2009:11).

The idea of initiating a local research project to study risks, safety and accessibility in public transport in Gothenburg was conceived in the summer of 2021 (Kindberg & Larsson, 2022). The project was to address in particular the trams in the city and how they have been modernised over many years. A group consisting of researchers from the Department of Social Work at the University of Gothenburg and the Chalmers Industrial Technology Group in Gothenburg came together with representatives from two disability organisations to launch and develop the project. The two organisations that participated were the *Association of Mobility Impaired Youth, Gothenburg Club*, and *The Swedish Federation of People with Mobility Impairment (DHR)* in Gothenburg.

DHR's Gothenburg division had been working to promote public transport accessibility and usability for wheelchairs since the 2000s and had been engaged since 2005 in official consultation and dialogue with the City of Gothenburg Traffic and Public Transport Authority, *Göteborgs Spårvägar* and *Västtrafik* with a view to making the tram system accessible to people with disabilities. This has resulted in Gothenburg now gradually switching over to accessible trams (see Appendix 1 with photo documentation, this report). Researchers in the Department of Social Work at the University of Gothenburg and the Chalmers Industrial Technology Group have also conducted various research projects concerning safety and mobility in transport and urban environments (Carlsson & Lundälv, 2019; Henje et al., 2021; Carlsson & Lundälv, 2022). It was thus only natural to enter into a collaborative arrangement in the present project.

The purpose of the study is to access the heightened knowledge and awareness possessed by representatives of the two disability organisations, i.e. the *Association of Mobility Impaired Youth, Gothenburg Club*, and *The Swedish Federation of People with Mobility Impairment (DHR)* in Gothenburg. Its purpose is also to study various reflections in the representatives' statements concerning the ways in which newer wheelchair-accessible trams are perceived by people who use (electric) wheelchairs, with an emphasis on mobility, safety, and comfort. Three specific questions have been formulated based on this purpose: 1) What obstacles and barriers, as well as opportunities, do the representatives from the disability organisations perceive in the new tram models as compared to earlier ones? 2) What risks do the representatives identify in connection with the new tram models? 3) What improvement measures did the representatives identify following a completed trip?

The study examines what is known in travel habit research as a 'journey' (Transport Analysis, 2018). A journey is movement that begins at one journey point and continues until the respondent reaches the same or a different journey point. Examples of journey points include one's own residence, another overnighting site, a workplace, or a school. The journey in our study extends door-to-door from home to workplace. This report presents the results of the research project conducted during the period 2021–2022. At the end of the report is a list of sources containing literature for further reading.

1.2 From the KOLLA Project to the present

The ways in which accessible public transport could be created and how the disability perspective could be strengthened have been under discussion in Sweden since the 1970s (Sveriges Riksdag (The Swedish Parliament). *Lag (1979:558) om Handikappanpassad Kollektivtrafik* [Law of Accessible Public Transport]) Krantz et al., 2009; Stjernborg & Svensson, 2021 Berggren, 2022). The development of and research on public transport in Gothenburg was, from 2005 to 2010, highlighted in the so-called *KOLLA* (Public Transport for All) *Project* (Lindahl et al., 2006; Lindahl & Odebo, 2007; Lindahl, 2007; Lindahl, 2008; Krantz et al., 2009). Attempting to create public transport for all enabled investments to be made in general rather than special solutions. The transport needs of multiple groups were to be addressed. Researchers from various backgrounds such as cultural geography, psychology and national economics collaborated in the *KOLLA Project*. The project was conducted in the manner of interdisciplinary research in which disability organisations took part as well.

The *KOLLA Project* included the M31 tram model and in its report stated that it 'is contributing to the modernisation of public transport in Gothenburg, which is an essential precondition for many with disabilities, as well as making life easier for all travellers' (Krantz et al., 2009:9).

Picture series 1. The M31, M32 and M33 tram models.

Picture: M31 tram model. Photo: Per Olof Larsson.

Picture: M32 tram model. Photo: Per Olof Larsson.

Picture: M33 tram model. Photo: Per Olof Larsson.

1.3 Disabilities and the social model

According to NTS (the National Travel Survey), nearly one in five Swedish people between the ages of 16 and 84 has one or more disabilities. Mobility impairments and hearing

impairments are roughly equally prevalent, i.e. approximately 10% each, while 4% have visual impairments (Transport Analysis, 2015).

The Transport Analysis (Transport Analysis) agency has, at the request of the government, mapped barriers facing people with disabilities in terms of their use of public transport based on their travel habits as compared to the rest of the population (Transport Analysis, 2018). Travel habits depend in large measure upon the type and degree of disability, age, and occupation. Public transport is used primarily for travel to work and school. The trips taken by those with disabilities total 1.2 per day, as compared to 1.6 for the rest of the population. The number of trips per day is lowest for those with mobility impairments (Transport Analysis, 2018).
Previous efforts to describe and clarify the various barriers faced in society by people with disabilities have been based on the social model, as was also the case in the *KOLLA Project* (Krantz et al., 2009:77f).

The social model stresses the importance of the surroundings, and that disability arises as a result of obstacles (barriers), i.e. structures in the society and the environment. Researcher Rafael Lindqvist writes: 'The social model focuses primarily on obstacles and deficiencies in the surroundings, such as inaccessible buildings, means of transport, institutions, etc., and on discriminatory attitudes' (Lindqvist, 2020:18).

According to the social model, society is the wholly dominant factor when it comes to creating disabled people (Barnes, Oliver & Barton 2002). Disabilities are the result of the way in which the society is organised, and not the individual person's physical or intellectual traits. Only once obstacles (barriers) have been eliminated can a person who is categorised as disabled live as others do, with participation and control over their life. The incidence of disabilities decreases when a society expands accessibility for those with disabilities (Barnes, Oliver & Barton 2002). The social model has been viewed as the antithesis of the medical model and has had a limited impact in a number of countries (Osman & Porkertová, 2022).

2. WHAT DOES THE RESEARCH SAY?

2.1 National research

Transportation and movement are decisive in the ability of people to experience participation and access to other spheres of life, such as work and education (Lindqvist & Lundälv, 2012). Studies show that disabled individuals who use a wheelchair have to apply for twice as many jobs in order to be called in for an interview (Bjørnshagen & Ugreninov, 2021). Research indicates that there is a lack of accessibility in society to enable people with disabilities to move about safely and securely. Marginalisation and a lack of flexibility in society can lead to poverty. Research shows that there are a number of risk groups in our society that are vulnerable to so-called *transport poverty*, social inequality, and *accessibility poverty* (Berg et al., 2019). Such risk groups include the unemployed, single parents (mainly women), ethnic minorities, and people with various disabilities. Research has focused in part on which protection factors are important for those affected by transport poverty in Sweden (Berg et al., 2019). From the perspective of social sustainability and equity, people with disabilities enjoy strong legal support in terms of requirements demanding that public transport be adapted appropriately.

The research in the area of disabilities has, for many years, been interdisciplinary with respect to the area of life comprising mobility and transportation (Krantz et al., 2009). Qualitative research was conducted during the 2000s in Gothenburg to study how people with disabilities experienced travel by public transport as transport service passengers. This research was conducted within the so-called *KOLLA Project* (Lindahl et al., 2006; Lindahl & Odebo, 2007; Lindahl, 2007; Lindahl, 2008; Krantz et al., 2009). The study showed that the driving style, service and how they were treated affected the travel options for many. Numerous functional aspects were identified, including that the participants had difficulty getting on and off, and that they experienced stress in those situations. A number also experienced difficulties in maintaining their balance while travelling.

The *KOLLA Project* research also showed that there were relatively few people with disabilities who had had accidents or injured themselves during trips on public transport, or who had witnessed such accidents (Krantz et al., 2009:74). The incidence of accidents was 2–4%. The study also indicated that the risk of falling on public transport was greater than in connection with transport services or trips on the flex line. The researchers found that the accident risks needed to be weighed against the potential positive effects of travel, such as increased physical activity and improved health for, e.g., older individuals.

Another Swedish study highlighted bus-related accidents in four municipalities from 2006 to 2009 and found that a total of 1,681 people had been injured (Berntman et al., 2012). The majority of those injured were unprotected road users who had been struck by either a bus or a tram.

One Swedish study indicates that there are multiple factors which determine whether, for example, an elderly person will use public transport. The likelihood of public transport use increases in areas of high urban density, and if the individual in question is a woman with high functional capacity (Ryan et al., 2015. Another Swedish study found that bus passengers were liable to sustain so-called non-collision injuries when, for example, the bus braked or accelerated. These injuries occurred as the bus was leaving the bus stop while elderly people

were boarding or alighting (Wretstrand et al., 2014). People using wheelchairs in connection with special transport had also been injured while travelling (10 per 100,000 trips). The Swedish study explains that this high incidence rate is attributable to the fact that many of these passengers are elderly, vulnerable, and readily fall victim to trauma (Wretstrand et al., 2010). Earlier studies in Sweden also show that the elderly and people with disabilities encounter barriers and difficulties in using public transport (particularly buses) (Wretstrand et al., 2009).

Numerous studies of public transport in Sweden show that there are various transport policies which set out clearly defined goals for travel quality for the elderly and those with disabilities. Studies have also shown perceived comfort and perceived safety to be significant quality factors. These factors are also interwoven with vehicle technology, system design, confidence, predictability, and communication (Wretstrand et al., 2008).

A qualitative study of the handling of complaints against public transport in Stockholm found that people with disabilities face numerous challenges in boarding and alighting from the vehicles (Stjernborg, 2019). The study showed that there were some drivers who neglected to use the accessibility equipment present in the public transport vehicle, or who treated people with disabilities poorly onboard the vehicle.

A literature survey concerning the importance of public transport for people reveals in part that low-floor trams and buses can only partly facilitate travel for people with disabilities (Book et al., 2016). Earlier research found: ‘A whole-trip perspective reveals that distances between transfer hubs, home and the stop pose a greater obstacle to elderly persons without disabilities than does vehicle accessibility. The relationship is the reverse for those with disabilities’ (Book et al., 2016:20).

Egard has studied the ways in which stairs pose barriers to accessibility for people with disabilities in urban environments, and points out how requirements promoting accessibility and those limiting accessibility can create a chain of often contradictory requirements. (Egard et al., 2022). The author believes that accessibility is characterised by half measures. The measures implemented, such as movable ramps, handrails and doorbells are often described as the only way to make stairs in the urban environment accessible. Measures intended to come to grips with an inaccessible environment also arrive at a late stage. The author considers that adaptive measures must be an immediate requirement. Egard believes that poorly implemented measures to achieve accessibility are a consequence of contradictory norms, values and interests in society. Style and tasteful design are prioritised over functionality and accessibility, or will be as long as architecture and design are viewed as art forms, at any rate.

There are also preconceived notions to the effect that inaccessibility is something natural or legitimate; barriers to accessibility are not merely a matter of economics and a lack of knowledge, but culture as well. Technical, cultural and financial obstacles must, therefore, also be taken into account.

Stjernborg describes the ways in which buses in the urban environment become an arena for confrontations between passengers with mobility issues and the transport system (Egard et al., 2022). This is attributable to the fact that public transport has increasingly been adapted for an ideal person, i.e. a non-disabled, financially stable passenger who uses public transport to get to and from work during office hours. This creates, in various ways, conflicting goals that affect the individual’s means of utilising public transport and problems for passengers who

need extra time, help and support. The researchers have studied the bus service in *Stockholms Lokaltrafik* and analysed passenger complaints. The results point out the problems that affect passengers with disabilities and impaired mobility. The most common complaint is that a bus fails to span the gap between itself and the platform. There are also complaints about lifts or stairs, a lack of support and help, or timetables. Obstacles are posed by narrow pavements, high kerbs, vehicles without ramps, and a lack of information. Other passengers, drivers or traffic control also pose obstacles, as does the organisation of the public transport system. The study's conclusion is that different capacities in terms of mobility and movement create a situation in which a passenger must often negotiate with the driver to come along on the trip.

Wästerfors has studied the ways in which 'accessibility hunters' move about in the urban environment and systematically discover barriers to mobility (Egard et al., 2022). These accessibility hunters encounter obstacles in the urban environment and bring about change by influencing the responsible officials. It is not enough simply to search and discover. The matter must be reported to the responsible authority and 'driven' further. But having to point out deficient accessibility is also a frustrating experience. The 'inaccessibility hunters' or 'inaccessibility detectives' formulate arguments in terms of how to put forward their discoveries. The inaccessibility hunters act and react in different ways. There are those who point out errors and mistakes without hesitation, while others react more gracefully. There are also those who criticise, mock or express anger, as well as some who avoid pointing out problems. The author stresses the importance of people with direct experience moving about in the urban environment and discovering, reporting and pursuing their cases with the responsible authorities. They also show how rules are applied to the environment without the responsible officials or builders knowing why. There is a difference between reading regulations about how, for example, the surface for a pavement should be designed and how someone in a wheelchair experiences using that pavement.

Hansson shows how a wheelchair user encounters unpleasant bus drivers. One interviewee is a young woman who uses an electric wheelchair on public transport and, like many young people, moves about in the society, going to cafes, buying clothes, meeting friends and so on. But she does not feel safe when she takes the bus, as she encounters bus drivers who are stressed, unpleasant, or brusque (Egard et al., 2022). The study focuses on the fact that passengers do not feel safe during the trip. In modern society, public transport plays a key role in terms of citizen safety, and feeling safe is essential when travelling by bus or train. But the passenger may feel unsafe not only during the actual trip, but also at the bus station and on the way to and from the bus station. Thus, the study analyses the relationship between safety and accessibility on public transport.

Various Swedish regional transport companies are also happy to present their policies regarding safety, security and accessibility for people with disabilities. In addition to describing unpleasant and hostile drivers, the respondents in the study also report feeling uncertainty about what might happen if something went wrong. This creates feelings of unpredictability. The author's conclusion is that safety and accessibility are interwoven, and that safety has both a legal and a moral aspect. They are concerned with the feasibility of travel, as well as having a good trip and avoiding the feeling that something could go wrong.

A number of other studies of the tram service have been conducted in Sweden. One highlighted the effect of trams on traffic safety for unprotected road users (Tyréns AB, 2019). Other studies of the tramway's properties, functions and potential in terms of personal

transport have been conducted in a number of instances (Hedström, 2004; Hedström et al., 2018).

One relatively new Swedish study which was part of an EU project looked into the conditions surrounding people with disabilities who used transport services and similar services (Echeverri & Salomonson, 2019). This qualitative study, which was based on 11 interviews, grew out of Agenda 2030 (sustainability targets 10 and 11) and was focused on inclusive and accessible transport systems for all. The researchers interviewed the respondents while also accompanying them on their actual trips in order to observe and monitor them. They also made field notes and photographed the trips. One important result that came to light was that people with disabilities experienced the trips as being physically uncomfortable. For example, a woman with fibromyalgia experienced travelling by tram to be extremely difficult, as it caused her increased pain because the tram shook and vibrated (Echeverri & Salomonson, 2019:10). The results also showed that it is very important for drivers to detect both verbal and non-verbal signals from passengers en route. The study further highlighted a number of different coping strategies which people with disabilities employed during the trips (Echeverri & Salomonson, 2019). This study resulted in a handbook which targets various actors within the local public transport system (Echeverri & Salomonson, 2020).

Over the years the City of Gothenburg and the Gothenburg Tramway Network have also published reports on sustainability, security and traffic safety for the tram service in Gothenburg (Göteborgs Spårvägar, 2019; Göteborgs Spårvägar, 2020; Göteborgs Spårvägar, 2022; Göteborgs Stad, 2020). At the university and college level, a number of students in various subjects have also conducted studies of the tram service in Sweden (Granath, 2012; Drexler & Johansson, 2013; Forsman, 2017).

2.2 International research

There are numerous other studies concerning public transport, mobility, and transport services. But there are also obvious limitations in those studies in terms of the extent to which they accommodate the social dimensions and a disability perspective, as they have mainly been traffic-related (Lucas & Jones, 2012; Lucas et al., 2016; Stjernborg, 2019).

International studies have long targeted public transport, security and safety. The tram service has been highlighted as well. One literature review found in the early 2000s that eight out of ten people with disabilities never travelled by tram (Wilson Mai, 2003). Research in the area of traffic safety and public transport also points to a number of future problems and challenges. Some studies show that there are a number of different types of risk which arise in connection with tram travel (Budzynski et al., 2019). Others have focused on investigating the degree of accessibility afforded by the tram service for people with disabilities (Jensen et al., 2002; Carlsson, 2004; Christakis et al., 2007; Currie et al., 2010; Currie et al., 2011; Macdonald & Coxon, 2011; Currie, 2016; Naznin et al., 2016; Podciborski, 2017; Diemer et al., 2018; Lope & Dolgun, 2020).

Other international studies have focused on accessibility, universal design, and discrimination in public transport (Schneider et al., 2015; Zajac, 2016; Sapkota, 2019; Unsworth et al., 2019; Park & Chowdhury, 2022; Wayland et al., 2022). One Finnish study elucidated in particular the effects of cold and climate on tram travel in Finland (Jensen, 2016). A Czech study based on a case study problematised the phenomenon of kerbs (accessible topology) and problems in inaccessible cities. People who used electric wheelchairs and their experiences with kerbs

were included in the study, in which interviews and observations of environments were collected over a ten-year period (Osman & Porkertová, 2022).

2.3 Partnership and user involvement

The focus of this study is on acquiring both the knowledge and awareness possessed by representatives from the disability organisations and the information which comes to light in their reports on mobility and travel on public transport, particularly with regard to trams as a mode of transport. The study is characterised by a research partnership in which researchers and representatives from the disability movement have worked together from the start to plan, conduct and, finally, write up the study together. This report also offers a methodological reflection on the content and results of this research partnership. The research on which we have drawn is thus participant-based.

Knowledge and experience are key to user involvement, and thus to a research partnership. What is knowledge? What knowledge is it that counts? These are two key questions that must constantly be raised in disability research (Beresford, 2002; Beresford, 2005; Nolan et al 2007). Author and interest-based representative Margareta Persson states that 'general research has, in principle, overlooked the living conditions of people with disabilities' (Persson, 2018:239). She notes that research has become focused more on the individual and medicine than on disabling barriers in our society. One way of increasing the focus on the social sciences perspectives is to enhance disability research with user involvement in the research, and to initiate multidisciplinary research on disability in the society (Brusén, 2021). In this way, the knowledge and experience possessed by people with various disabilities could be translated into practical action.

Research partnerships have been referred to in the literature using various terms, such as collaborative research, action research, user participation, inclusive research, participatory research (partnership in participatory research), participant-based research, active involvement, citizen science, and patient participation (Larsson et al., 2016; Lindberg, 2016; Hecker et al., 2018). One example of citizen science described by Lars Lindberg is when, for example, users can 'document problems with accessibility in public transport and provide information about how they can actually get somewhere' (Lindberg, 2016:47). Citizen science is characterised by participation, local knowledge, curiosity, and innovation (Danielsen et al., 2018; Hecker et al., 2018; Mahr et al., 2018; Shirk and Bonney, 2018).

Co-ownership in research has also been discussed in the literature, based on the disability movement in Sweden and its definition of the term (Wermeling and Nydahl, 2011; Larsson et al., 2016). The importance of research partnerships has been described and discussed internationally in a number of contexts, including based on the slogan *Nothing About Us Without Us*, and in terms of the ability to enhance disability research with user involvement (Charlton, 1998; Priestley et al., 2010; Burke and Byrne, 2020). The value of user involvement in research has long been emphasised in various studies in Sweden (Starrin, 2005; Larsson et al., 2016; Högberg et al., 2017; Lundälv et al., 2022). The disability movement in Sweden was the primary driving force behind disability research in the 1960s and 1970s (Söder, 2009).

What arguments are there in favour of incorporating user involvement in such research? Researchers Malterud and Elvbakken cite several key arguments (Malterud and Elvbakken, 2021). The first is the so-called ethical argument, which means that users have the right to

participate in research of importance to their own living situation. There is also a quality-based argument to the effect that disability research is strengthened, in that it becomes better and more relevant. There is also a third reason, namely a therapeutic argument which states that a research partnership can have a positive effect on the user (Malterud and Elvbakken, 2021:82). User involvement in research has also been problematised in a number of contexts by several authors in the disability field (Lindberg, 2016; Persson, 2018; Brusén, 2021). It is claimed, among other things, that disability research has not been prioritised to any great extent in Sweden. The need for a critical perspective in user involvement has also been cited from a multidisciplinary perspective. 'Critical perspective' is to be understood to refer to the ways in which user involvement can be made more constructive and developed further (Skjeldal, 2021). The research partnership also means that the participants can play an active role as co-researchers, which entails that they plan, collect material, analyse and, together with researchers, write an article or report.

Participatory research in Sweden has been mapped by the *Agency for Participation*, which found that numerous researchers are calling for more participant-based research in society (Myndigheten för delaktighet, 2017). The importance of 'user involvement' is emphasised in the research, which means that people with disabilities want to see that research results are being translated into practice (Myndigheten för delaktighet, 2017:37). The knowledge overview focused specifically on participant-based research regarding technology and design processes. In recent years a number of studies have highlighted the Covid-19 pandemic and its consequences for people with disabilities (Tideman et al., 2021; Lundälv et al., 2022). Participatory research has been a vital starting point for such studies as well (Lundälv et al., 2022).

Important starting points in terms of user involvement have to do with the need for the participation and influence of the disability organisations to be real, and capable of strengthening our democracy. This means that the researchers who are to embark on a study must be able to share both influence and power in the research process. One knowledge overview conducted by the *Agency for Participation* states that such participatory research must incorporate various elements. First, the ways in which the various research partners are to participate in the project must be clearly delineated. Second, the roles and responsibilities of the parties must be defined, as must how their various perspectives are to be utilised. Finally, it must also be possible to evaluate the research partnership in practical terms at the conclusion of the project (Myndigheten för delaktighet, 2017:43). Such an evaluation need not only occur internally with a research project, but may also be presented publicly. Earlier exploration on the ways in which user involvement in research has been noted in the media and the public sphere indicates that it has been mainly the researchers themselves and their voices that have been discussed. The ways in which representatives from the disability movement have perceived and experienced user involvement have been obscured (Larsson et al., 2016; Lundälv, 2017).

Our project

The tram study was conducted during a special time, i.e. the Covid-19 pandemic. This means that great caution was exercised in both the project meetings and the trips on public transport (trams), as the various research partners involved in the study also constituted a particular risk group. To manage the risks during the pandemic, digital meetings were held, and the trips were made in safe ways, as travel was also limited.

The first project meeting took place in September 2021. Three senior researchers were involved in the project (two from the social work field and one from the machine and vehicle systems field), along with two representatives from the *The Swedish Federation of People with Mobility Impairment (DHR)* in Gothenburg. The participant-based research in the project consisted in that the representatives participated in the project meetings, commented, wrote texts, travelled in the various tram models along with a researcher, and reflected on the process. Because they are representatives, they can also reflect on accessibility, mobility and movement via tram based on the needs and desires of the organisation members. As authors, we occupy an outsider position, which means that an ethical question arises as to the extent to which we are able to understand people with disabilities and their own ways of interpreting both situations and various experiences. This is a topic discussed both in earlier studies and within the disability movement (Wermeling and Nydahl, 2011; Larsson et al., 2016:680; Burke and Byrne, 2020; Skjeldal, 2021).

Methodological reflections
What methodological reflections on the content and results of the research partnership are possible based on our study? The study was unfunded, resulting in an absence of potential financial ties to funders and providers of public transports. The study was conducted by participants from the University of Gothenburg, *Chalmers Industrial Technology* and the disability organisation *DHR – The Swedish Federation of People with Mobility Impairment.* The constellation of the project group enabled an interdisciplinary approach and offered excellent opportunities to shed light on the sphere of life comprising *transport and movement* from a multifaceted perspective.

2.4 Experiential knowledge

One starting point in the position document issued by the disability organisation *The Swedish Federation of People with Mobility Impairment (DHR)* in 2013 is that personal experience constitutes decisive knowledge. The document states as follows: ‘No experience can compare with personal experience. This is why it is primarily members with personal experience of impaired mobility who must represent DHR and advance the organisation’s cause. Respect for one another’s disabilities is decisive for our work’ (Wermeling, 2013:5).

Ellström (1992) reports on various ways of viewing competence, i.e. an individual’s potential capacity to act in relation to a given task, situation or context. Competence always stands in relation to tasks, and is a special form of ability. Competence is present when the individual’s needs and ability to solve the problem are in accord. The competences of wheelchair users and researchers differ, but they do have some factors in common. Competence can be described based on the following factors: 1) psychomotor factors, 2) cognitive knowledge, 3) affective factors, 4) personality factors, 5) social factors.

Psychomotor factors are often referred to as ‘hands’. The wheelchair users in the project group have the ability to travel by tram. They can perform the manual actions required to activate the boarding ramp and attract the driver’s attention. For their part, the researchers know how to formulate and structure a research text. Cognitive knowledge, i.e. intellectual skills, constitutes another type of knowledge. These can have to do with the ability to solve problems or make decisions. The wheelchair users know how the public transport system works for a wheelchair user, as well as how to get about when the public transport system is down. The researchers know what requirements a research-based text is subject to, and how it is to be presented and disseminated.

The affective factors have to do with the will to do and sense of doing, commitment, values, etc. Both the wheelchair users and the researchers share a commitment to making public transport accessible. Personality factors include, for example, personality traits such as self-confidence and self-perception. The social factors pertain to, for example, the ability to cooperate and the ability to communicate. Both wheelchair users and researchers in the project group are accustomed to cooperating, and to intermediating collective and individual projects.

Propositional knowledge, skill and familiarity
There are also other ways to describe different forms of knowledge. Tore Nordenstam differentiates between three types, the second and third of which are, according to Nordenstam, forms of tacit knowledge (Nordenstam, 1984:23f). Theoretical knowledge (propositional knowledge, 'know that', knowledge *that* something is the case) consists in a belief in the veracity of true and well-founded propositions. Propositional knowledge is intermediated via textbooks, lectures and other forms of verbal communication. Practical knowledge (skill, 'know how', knowledge about *how* to do something) consists of skills or abilities to perform practical tasks, e.g. the ability to get about in a wheelchair in the traffic environment. This is a skill that is learned through practical training. All the wheelchair users who are participating in the project are familiar, based on their own practical experience, with the living conditions surrounding wheelchair users, associations that organise people with disabilities, and how to get about in a wheelchair in an urban environment. It is certainly possible to describe something of how this is done, but then the verbal communication process also comes into play. However, language is normally of limited significance. One can never learn a skill such as that of operating a wheelchair based *solely* on instructions, but rather on instructions in combination with personal experimentation. Familiarity is the ability to recognise things. Much of what is described as skill can also be said about familiarity. One example of familiarity is the ability to recognise human faces or a piece of music. A person can recognise someone's appearance or a piece of music while being unable to *express* that knowledge solely in words.

2.5 The Haddon Matrix

The study has two points of departure, i.e. the entire journey (Olsson, 2003), and Haddon's matrix (Haddon, 1980a; Haddon, 1980b; Björnstig, 2001; Peden et al., 2004; Yarnell, 2007). The Haddon Matrix is a theoretical model used to understand a traffic injury context and the injury-reducing factors that are present. The Haddon Matrix is also the most common epidemiological model used in the prevention of personal injuries (Haddon, 1972; Nygren et al., 2000; Andersson & Nilsen, 2015). The matrix is used by the World Health Organization (WHO) and the World Bank to achieve a global understanding of one of our major public health problems, i.e. traffic injuries (Peden et al., 2004). The matrix originally comprised three different factors, i.e. the human, vehicles and equipment, and the environment, which comprises both the physical surroundings and the socioeconomic conditions. These various factors are related to three crash phases, i.e. pre-crash, crash, and post-crash. The Haddon Matrix may be viewed as an entire chain which is analysed (Björnstig, 2001). The matrix can also be used to derive targeted measures. The terms *primary prevention* (the phase before and during a collision), and *secondary* and *tertiary prevention* (the phase after the collision) are used (Nygren et al., 2000)). The Haddon Matrix is viewed based mainly on three different prevention options: 1) the ability to prevent the accident, 2) the ability to prevent injury as a

result of the accident, and 3) the ability to prevent the consequences of an injury (disability, fatality) (Andersson & Nilsen, 2015:34).

Phase	Human	Vehicles and equipment	Environment
Pre-crash (Crash prevention)	Information Attitudes Impairment Police enforcement	Roadworthiness Lighting Braking Handling Speed management	Road design and road layout Speed limit Pedestrian facilities
Crash (Injury prevention during the crash)	Use of restraints Impairment	Occupant restraints Other safety devices Crash-protective design	Crash-protective roadside objects
Post-crash (Life sustaining)	First-aid skill Access to medics	Ease of access Fire risk	Rescue facilities Congestion

Figure 1. The Haddon Matrix (Peden et al., 2004:13)

The Haddon Matrix has been used in a number of different contexts and studies, including to investigate the means available for both electric wheelchairs and rollators to move about in the street (Carlsson and Lundälv, 2019; Henje et al., 2021; Carlsson and Lundälv, 2022). In our study, we proceeded based on the Haddon Matrix and modified it specifically for public transport. An additional level, i.e. the social level, has been added to the Haddon Matrix.

	Human factors	Wheelchair factors	Environmental factors	Social factors
Pre-crash Crash prevention	Training, knowledge Interactions with other road users Disability-related challenges Managing risks and safety	Technical problems Poor visibility and field of vision Low temperature and precipitation	Trams and stops Faulty, sloppy and poor maintenance Precipitation and poor snow removal	Vision Zero CRPD (UN Convention on Human Rights) Swedish Discrimination Act (SFS 2008:567) Agenda 2030
Crash (Injury prevention during the crash)	Balance	Technical problems Poor visibility and field of vision Low temperature and precipitation	The interior	Vision Zero CRPD (UN Convention on Human Rights) Swedish Discrimination Act (SFS 2008:567) Agenda 2030
Post-crash (Life sustaining)	Interactions with other road users Disability-related challenges Managing risks and safety Coping Mental condition	Means of evacuation	Emergency healthcare treatment Rehabilitation and support Insurance systems	Vision Zero CRPD (UN Convention on Human Rights) Swedish Discrimination Act (SFS 2008:567) Agenda 2030

Figure 2. The Haddon Matrix modified to analyse preventive work and awareness in the realm of public transport.

Because interviews and participatory observations were carried out using the Haddon Matrix as the starting point, the material was obtained from all three trams, i.e. M31, M32, and M33. The interviewees do not generally differ based on the different tram types in reporting their experiences.

The entire journey entails that if some part of the journey is inaccessible, e.g. if it is not possible to get from home or from a stop because the lift in the residential housing is out of order, the road to the stop is impassable due to level differences, the structures themselves, or because a usable path is simply absent, then it is impossible to use public transport.

Göteborgs Spårvägaralso proceed based on Vision Zero in their operations. They also engage in systematic traffic safety work, which is described as follows: ‘We view Vision Zero as an important part of our efforts against accidents resulting from our operations, and it is self-evident that every passenger must feel safe on our trams. That is why we are working with preventive measures to improve traffic safety. When serious accidents occur, an accident investigation is conducted to identify those areas that need to further development. Our traffic safety work is both a proactive and reactive tool for developing safety over time’ (Göteborgs Spårvägar, 2022:60).

3. METHOD

We have used a qualitative method in gathering material in the project. The method consisted mainly of reviewing and analysing documents (policy documents), qualitative interviews with representatives from the organisations, participatory observation (case study), field notes and photo documentation in connection with trips made by tram, as well as a review of earlier research. The qualitative interviews conducted were in the nature of qualitative expert interviews with representatives from disability organisations. Participatory observations were made within the framework of the research project over four observation periods, i.e. the summer, autumn and winter of 2021, and the spring of 2022. In this way, participatory observations were made during tram trips in every season of the year. The gathering of material took place during the Covid-19 pandemic, with the result that restrictions on movement and transportation were in place within our society.

During the project period we also conducted recurrent meetings in which experiences and policies were discussed. The policy that served as the starting point for the project is based on *Nollvisionen* [Vision Zero] and *Hela Resan och inga särlösningar* [The Entire Journey and No Special Solutions] (Proposition 1996/97:137; Olsson, 2003; Johansson, 2009; Krantz et al., 2009; Belin et al., 2012).

3.1 MATERIAL

The sample consists of representatives from two organisations, i.e. the *Association of Mobility Impaired Youth, Gothenburg Club* and *The Swedish Federation of People with Mobility Impairment (DHR), Gothenburg division*. The sample comprises individuals described as representatives and 'influencers' as per Söder's categorisation (see appendix report to SOU 1990:19 'Influence for persons with extensive disabilities. Summary of results from an interview study at the request of the National Disability Inquiry'). They are accustomed to describing their experiences, meeting with government agencies, and advocating for their rights. The informants were chosen in consultation with officials from *The Swedish Federation of People with Mobility Impairment (DHR), Gothenburg division*, and constitute a strategic sample of representatives from the two disability organisations, i.e. the *Association of Mobility Impaired Youth, Gothenburg Club* and *The Swedish Federation of People with Mobility Impairment (DHR), Gothenburg division.*

Structured interviews were conducted with all representatives, based on the Haddon Matrix and the Entire Journey. Photo- and video documentation of the tram trips was performed as well.

3.2 ANALYSIS AND PROCESSING

We used the theoretical model known as the Haddon Matrix as the starting point for the analysis in the study. The empirical data were analysed based on various reports and experiences derived from the trips on the three tram models, i.e. M31, M32 and M33. The interviews conducted and notes recorded during the tram trips were transcribed and then analysed by the researchers in the project.

3.3 ETHICS

The participants in the research project collaborated as experts and representatives for the disability organisations at a relatively overarching and general level. This means that no personal data were collected in the research project. The participants were informed of the purpose of the research study. They gave their permission for their anonymised material to be used in the research. We have complied with the research ethics principles and recommendations formulated by the Swedish Research Council (Vetenskapsrådet, 2017).

In connection with the study, we observed and interacted with other passengers on the trams without their being informed about the study in progress. We are aware that this has significance with respect to the study results, but have taken it into account. This is something that has been noted in earlier studies as well (Echeverri & Salomonson, 2019; Osman & Porkertová, 2022).

4. RESULTS OF THE TRAM STUDY

The results of this local study will be presented in this chapter. Three areas have been investigated in particular, i.e. 1) Risk environments and risk factors in tram models, 2) Risk management and accessibility, 3) Comparison of two tram models. The chapter concludes with a summary of the results.

4.1 RISK ENVIRONMENTS AND RISK FACTORS IN TRAM MODELS

The members of the DHR organisation who participated in the municipality's development of accessible trams emphasise that they have had two benchmarks. The first is that they must promote *independent riding*. This means that, during the trip, it must be possible to travel without help from an assistant, the tram driver, or other passengers. The second benchmark is *no special solutions* for people with disabilities. This means that wheelchair users must not be referred to special paths, locations or parts of the tram, nor may they be referred to a transport service.

Accessibility for electric wheelchairs
There are three tram models in Gothenburg that are wheelchair accessible. There are three categories, i.e. manual wheelchairs (Class A), electric wheelchairs for limited outdoor use (Class B), and electric wheelchairs for outdoor use (Class C). The first two, classes A and B, can be used on trams. The dimensions (max. 1.2 m long, 70 cm wide) and weight (350 kg on trams/250 kg on buses, including the operator) determine whether one can ride the tram. 'Mobility scooters' such as the MiniCrosser (three-wheel) fall under Class C (Svensson, 2020).

Accessible trams
The M31 is the first articulated tram. It is based on the M21, which was produced by ASEA/ASJ from 1984 to 1992 by incorporating a low-floor area as a middle section. This became the M31, which was delivered from 1998 to 2002. Eighty trams of this model exist. The low-floor area has a door with a ramp. It also has a manual ramp which the driver can deploy if the electric ramp is not working. Prior to the introduction of this tram it was, in practice, impossible for wheelchair-bound people to ride a tram. The M32 is a low-floor tram produced by Anselbreda, which began to be delivered in 2004. There are 64 of this model. It has four doors, one of which has a ramp. The M33 is also a low-floor tram, built by Bombardier. Ten of a total of 40 ordered trams were delivered in 2020, with final delivery slated for 2022. The M33 has six entry points, each of which has a ramp.

4.2 RISK MANAGEMENT AND ACCESSIBILITY

Individual factors

Interaction with others in the traffic environment
Because the respondents are unable to move about in the tram, they cannot change their location if intoxicated or confrontational passengers climb aboard. However, the respondents report seldom encountering angry, hostile or intoxicated passengers on the tram. On the other hand, they often do encounter fellow passengers who push themselves forward, stand in the way, or fail to queue up properly. This occurs most often while boarding, with numerous respondents reporting instances of pedestrian passengers pushing themselves forward or not leaving enough room.

One respondent reports that *'It happens that you have to ask fellow passengers to move out of the wheelchair area. They often do so, but not always. Then you may be stuck in front of the double doors with a wheelchair. But you can't get off again because maybe you have an appointment to make, or it's cold outside'*.

Drunkards loiter at some stops, drinking alcohol. Even though they are pleasant for the most part, they do create uncertainty, and may be perceived as bothersome. It is not as easy for a wheelchair user to move away as it is for a pedestrian.

According to one respondent, there is a gender aspect to this. Female passengers are likely to feel more uncomfortable when encountering intoxicated people who are drinking alcohol at the stops, particularly if there is a group of them.

But it also happens that fellow passengers will offer to help lifting on or off when they see that the respondent is having trouble during a transfer. One respondent reports being uncomfortable when other people come and ask directly if they would like assistance. It is also stressful when people do not understand how the ramp works. The respondent: *'I can understand them asking, and it's actually nice as long as they respect "no" or that I can't respond because I'm so stressed out, or when they help me against my will. I can feel stressed out when I have to get on a tram'*.

It can be difficult to turn around while in transit to see where you are, or to check the display that shows the next stop or indicates whether the tram will be stopping at the next stop.

As a wheelchair user, buying a one-way ticket from the ticket machine inside the tram requires one to have a lot of room to position oneself in front of the machine, as it must be totally free of prams and rollators.

Using public transport requires the help of an assistant in most cases.

Getting on or off the tram is a challenge if the distance between the tram and ground level is so great that the ramp tilts steeply. At some stops the transition from stop to the nearest street is so steep that it makes it difficult to get there, or the wheelchair user is forced to take a considerably longer route.

Managing risks and safety
One respondent reports avoiding public transit in the evening and at night because of threatening and unpleasant fellow passengers, as one cannot get away from what is happening by going elsewhere, or hop off and wait for the next tram. One also does not know whether anyone else has been troubled by this, or whether the driver has noticed it.

A wheelchair user must travel with their back towards the seat in a wheelchair space, as otherwise there is a risk that the wheelchair will become a 200-kilo projectile if the tram brakes hard. But that requires that the space not be occupied by a rollator user or a pram.

If a wheelchair user positions themselves in a space intended for wheelchairs, it is not possible to chat with a fellow passenger seated at a distance. If the fellow passenger positions themselves adjacent, then the wheelchair user has to chat 'upwards', an uncomfortable position for many.

It is also difficult, if not impossible, for multiple wheelchair users to travel together, particularly if they are using electric wheelchairs, which weigh so much that they would exceed the maximum weight limit.

On the new M33 there is a very small strap in the wheelchair space to secure the wheelchair. One respondent wonders whether they should fasten themselves in securely, but '*I don't have a good feeling about how I'm going to get myself out if anything happens. So it becomes stressful. I find it awkward with a lot of people present, but if I want my wheelchair fastened in then I can't move about. It's not safe anywhere. I have to hang on'.*

Wheelchair-related factors

Technical problems
In some cases the respondents have had problems with their wheelchairs, such as electrical faults or a footrest coming loose. One respondent's scooter had died numerous times during the study period. It had started up again after a few minutes, or after an hour on one occasion. Improperly inflated tyres can cause the brakes to fail to work if the tram brakes hard, with the risk that the scooter will slide and potentially run into another passenger.

Poor visibility and field of vision
Sitting in a wheelchair means being situated lower down than one's fellow passengers. It means that it may be difficult to get a good overview of the tram or to see out the windows. The respondents note that this can be problematic if they are unfamiliar with the route.

It is difficult to find space in front of the ticket machines, particularly for travellers using wheelchairs.

Low temperature and precipitation
Sitting in a wheelchair means exposure to cold, but it can also be stressful to travel in a wheelchair if it is extremely hot and there is a long wait.

The trams are equipped with heating fans under the seats in the lower middle section on the M31. In wintertime it had been windy, cold, snowy and rainy. Under normal circumstances it

is then not possible to take public transport, due to the risk of getting stuck at a stop waiting for an accessible tram.

Environmental factors

Trams and stops
The major challenges faced in taking public transport arise during boarding and alighting. It is stressful not knowing whether you will get on or not. It is also stressful when a ramp is required for an electric wheelchair, such as most of the respondents use.

One respondent reports: *'In the evening we may sit and wait for half an hour, and if it's cold then you get chilled, as there isn't much protection if they haven't set up good wind screens. One gets really chilled sitting there and waiting at the stop'.*

Improper snow removal means that one must take alternate routes and risk getting wet.

Sometimes the announcement for the next stop is indistinct or goes completely unheard. It also happens that the tram will rattle, drowning out the announcement.

It often happens that the ramps on the older trams get stuck, because of a design flaw. When the ramp is retracted, it also pulls in gravel, which causes it to get stuck, particularly during the winter.

On all three models there is only one entry with an electric ramp.

The centre aisle in the M33 is too narrow, with the result that a wheelchair user cannot get to the ticket machine if they board through the wrong door.

All trams must be equipped with ramps, but at many stops the distance between the tram and the ground is so great that the ramp rises so steeply that it is not possible to get onboard if, for example, it is raining. There is a risk that the chair may slip, or that it might quite simply tip over during boarding or alighting.

In the case of a respondent in a manual wheelchair using a ramp, they may require help from someone to push them, or to hold them back when alighting.

Not all respondents use ramps. One would climb onto the trams or bus and then lift their manual wheelchair onboard with a tug. When the respondent got off, he simply hopped off holding the chair. However, this poses a risk in that the footrest might snap when it hits the ground. It is also inconvenient if there is a large height difference between the tram and ground level.

Wheelchairs do not have springs, and old, worn-out trams lurch, toss and shake, making them uncomfortable to ride, leading to back pain.

Construction work is sometimes in progress at a stop, entailing a risk of ending up in a gravel pit or puddle when alighting. An assistant is then needed to remedy the situation.

It also happens that a respondent may get to a stop only to find that it cannot be used, because of work being done or improper snow removal. If it is dark as well, as it often is in the winter, it may be difficult to notice construction work from afar.

It was totally impossible for a wheelchair user (see Appendix 1) to alight at certain stops in the city where the study was conducted. One traveller who uses a manual wheelchair with a small caster in front is dependent upon there being no high kerbs, potholes or pits along the entire route from starting point to final destination.

Faulty, sloppy and poor maintenance
One commonly occurring problem is that the ramp is not working. This is a common problem on the older M31s. The driver must then be notified and come and deploy a manual backup ramp, wait until the wheelchair has boarded, and then remove the ramp and put it back into its place.

It also happens that the display will fail to work because, for example, the lighting is weak or out of order. Strong sunlight or glare on the screens can also be problematic.

To board a tram, a wheelchair passenger must push a button on the side of the tram to notify the driver so that they can activate the ramp. One respondent: '*I can imagine that an outsider or unaccustomed person would find all this with the buttons and how they work to be complicated. If, for example, you're sightseeing in Gothenburg, it can be really difficult, or times when I've travelled with friends who have an assistant and the assistant didn't understand how to use the button, or things like that'.*

To alight, the person must push a blue button to notify the driver that a wheelchair passenger wants to get off. The driver must then push their own button to activate a yellow blinking button that activates the ramp. It is not unusual for any of these buttons to fail to work, or for the driver to fail to notice that the button has been pushed.

One respondent reports: '*Messed up ramps, (laughs), there are some. It has happened that they shut down completely, so that the tram had to stand there for a really long time, then someone had to come and fix it. Sometimes the driver knows full well that the ramp is broken, so they have to come with a manual one. It's been a bit spotty on the older models. Some drivers manage it really well, some don't seem to know how to use the ramp, and it has happened that I've tried to explain it to the driver. You also find that the driver doesn't give a crap and doesn't come with the manual ramp. Then I stand there and press the button a really long time, and have to push it in a panic to get on board'.*

Another respondent reflects: *'When such incidents happen I find it hard to know whether it's a technical fault or whether the driver is stupid or doesn't give a crap about you. I have pushed the button and the tram just rolled away from me, and then I don't know whether the driver didn't see me or just doesn't care. I can't tell. It's hard to know how things are in terms of knowledge, but sometimes you can almost believe that the driver doesn't know what to do to deploy the ramp, and then you are amazed that the driver doesn't know that. Is the driver incompetent, are they stressed out or malicious and they don't want you on board? Or something else?'*

Some stops have large height differences between the stop and ground level. One respondent: '*The ramp is very steep and I have to brace myself to get up. Often I'm able to do it. Then it*

can be nice if someone comes and helps me, but I wish it was working, so that I won't need to get help if it's steep'.

Lifts are installed at some stops. They are sometimes used as urinals, which makes them disgusting to use.

Precipitation and poor snow removal
The protection against the wind is poor when it is windy and rainy. Sometimes the glass windows are broken. The entire trip will be impossible if one succeeds in getting to the stop only to have a pile of snow force the traveller to return home.

One respondent who travels a long distance from their residence to the tram stop on a scooter has suffered as the result of a dispute between administrative bodies over which one is responsible for clearing the snow along a 30-metre stretch. The result is that it becomes impossible to get to the stop to take public transport.

Structural problems
Regulations can create numerous problems for people with disabilities. The city had the same system of rules in place throughout the study period, although it has changed policies and now requires certification to replace a broken scooter in a different way than previously.

One respondent notes: '*It's been a long time since they've required a doctor's certificate for me. It's stressful when they have to reassess you, if they come to require a certificate even though you've had transport service since you were born. You still have to get a certificate all over again. It's just difficult and annoying. It feels unnecessary in some way; my disability doesn't change, and the transport service hasn't been revolutionised in any way. So it's just annoying. They follow up once a year to see whether I need a wheelchair or not. It feels very stressful, knowing that they can take it from me when I'm getting so much benefit from it. I can understand them wanting to do the occasional follow up, but every year seems a bit…just this thing. I have a hard time trusting that they want what's best for me, but I'm so afraid that they will take it from me'.*

One respondent had their assistance cancelled due to changes in the regulations. As a result, they now travel by transport service between their residence and workplace, rather than taking public transport as they did previously.

The study shows that urban planning can involve a compromise between different ways of moving about in the streetscape, e.g. between pedestrians and pedestrians with vision impairments, bicyclists, motorists, and wheelchair users (see Appendix 1). Such compromises mean that no one will be completely satisfied with the design.

5. DISCUSSION AND CONCLUSIONS

The study has identified a number of interesting opportunities and potentials for promoting safety and expanding measures to prevent against the risks and accidents that can occur while travelling by tram in Gothenburg. People with different disabilities must have the means of making their entire journey using public transport (Jensen et al., 2002; Carlsson, 2004; Lindahl et al., 2006; Lindahl & Odebo, 2007; Lindahl, 2007; Lindahl, 2008; Krantz et al., 2009; Lindqvist, 2020; Park & Chowdhury, 2022). Making the entire journey means travelling from its starting point, which can be a residence, until they reach their destination, a workplace (Lindqvist & Lundälv, 2012). It must be possible to traverse the route to the tram stop. A usable bus or tram must come along, with everything working properly all the way to the destination.

People with various disabilities do not use public transport to the same extent as the rest of the population. The majority of trips made by people without disabilities comprise work and school trips, while people with disabilities make far fewer work and school trips. They do make rather more shopping and service-related trips. Researchers confirm that this may be due to obstacles in the public transport system (Transport Analysis, 2018).

Multiple prams may occupy the space where a wheelchair is to sit at many tram stops leading up to transfer points. This means that passengers with wheelchairs have to wait and take into account that they will have to wait for several buses or trams before they can continue on. If it is raining or cold, this makes the trip practically impossible. Another obstacle is that the trip per se entails stress and anxiety over what will happen, or worry that one will not even reach one's destination.

A lot of things have to work properly during the trip. It must be possible to prepare to board or alight at a stop, the driver has to see that someone is pressing the blue button, and the tram or bus must not be completely full. Nor should there be any intoxicated or obtrusive people on the tram, at the stop, or on the route to or from the stops, with no prams on shuttle buses, etc.

One particular challenge arises when a wheelchair passenger begins a trip, but upon transferring discovers that it is impossible to proceed because the tram is full or inaccessible, or the vehicle ramp is not working, or because the wind and rain protection is inadequate or broken in bad weather. This results in the wheelchair passenger choosing to travel further in their wheelchair rather than risk getting stuck at a transfer stop. This in turn presumes that the way has been shovelled in wintertime, that it is not raining or too windy, and that no unforeseen obstacles arise. Transferring is, like boarding and alighting, highly stressful.

The results of our study show that the respondents avoid transfers, in part because they cannot always determine which tram is coming and whether the one that is coming will be accessible, but also to avoid an unsafe ramp. It is easier to go further by wheelchair than it is to wait for an accessible tram or, even worse, a bus.

There are few means of circumventing a problem if one is using a wheelchair, as opposed to other travellers who can perceive alternate routes. If the tram is not running, they can take a bus on an alternate route. If they do not get off at Marklandsgatan, they can continue on to Högsbotorp. A wheelchair user, and particularly a manual wheelchair user, will choose different routes – ones that are free of kerbs, pits, bad asphalt, hills and soft ground – than a

pedestrian, and they will develop a sort of familiarity with getting places in a wheelchair in a traffic environment. Through practice, the wheelchair user creates a mental map. This map looks different to that of the pedestrian (Nordenstam, 1984:23f).

The number of unsafe moments creates stress and increased transport poverty. The mere knowledge that something might happen leads to ‘travel stress’ or ‘public transport stress’, which manifests in different ways, such as irritation with fellow passengers or frustration over the inability to get to school or work on time.

Stress regarding technology has been noted in the study, e.g. primarily when a ramp fails to work, stress because the driver fails to notice that one needs to get off, and stress over changing trams where it is possible to take the next one. Such stress leads to various reactions, such as irritation with fellow passengers, an exaggerated need for safety and control in terms of all the technology working properly, the assistant having to make sure that the driver is aware, or that one quite simply avoids using public transport altogether.

5.1 Proposed measures

The study points out the need for a number of initiatives targeting not only the traffic and the trams, but other parts of the public space as well. Greater emphasis must be placed in future on the entire journey, i.e. the route to and from the tram stop. For example, the personal assistant must function in practice, and lifts and doors in the residence must be usable.

The study points to the importance of having support during the trip, i.e. an attendant or assistant who makes the tram trip feasible in practice. One respondent has stopped using public transport because such assistance has been withdrawn. A tram attendant could serve as a step toward independent travel. This could also be a solution for many other groups of transport users, as the tram attendants would not be there solely for those using wheelchairs.

There are many groups who need accessible vehicles, and it is consequently important to be able to shift the focus from wheelchair users on public transport to travellers who need safe and secure travel, the elderly, workers carrying tools, pregnant women, and passengers carrying multiple packages or tote bags.

Another proposed measure for cultivating security in connection with tram travel is to introduce a so-called ‘real-time app’. With a real-time app the traveller can see, in the app itself, whether it is possible to transfer at a particular junction based on a graphic showing, in real time, whether the stop has been dug up or its protection against the elements has been compromised. Such an app would also make it possible to see whether it is possible to use public transport when the city is bustling and crowded, e.g. at graduation time, when there is crowding at Liseberg Amusement Park, or when football fans are passing through the city. One proposal could be to link the real-time app to traffic and weather cameras throughout Gothenburg.

A third proposal that has arisen in the project involves investments in service centres, i.e. so-called ‘heated shelters’ at the major transfer hubs. Such a measure could also be another step towards ‘no special solutions’. The heated shelter could, for example, include a kiosk serving coffee. If the heated shelter is guarded, this could also be seen as a measure to enhance security. A fourth proposal to create secure and comfortable environments in connection with tram travel for all would be to create ‘integrated tram stops and bus stations’. Examples of this

include the roofs over buses at Frölunda Torg and Angered. Transitioning to electric buses would mean no exhaust gases in a transport centre.

Two other proposals for fostering security and preventing injuries during tram travel could involve the introduction of so-called ‘hub attendants’. These attendants would be present at the major transfer hubs, and would be tasked with assisting travellers in boarding and alighting, and with furnishing advice and information as to the best routes. Finally, lowered tracks could enable greater accessibility, with the result that ramps would not be needed in those environments.

Based on the study results, it is also possible to determine which measures would improve both security and safety during tram travel in the city in concrete ways. It is important in this context to be cognizant of the tram models and their various designs. It is also important not to sacrifice style and tasteful design at the expense of functionality and accessibility.

Our study also shows that there are knowledge gaps with regard to the evacuation of trams in connection with, for example, an accident or fire-related incident. What do the evacuation plans for tram passengers with disabilities look like? Who is responsible for evacuation in the event of a fire, or for evacuating the tram before the emergency services are on the scene?

5.2 Further research

Our research study shows that there is still a need for research concerning the sustainable city as a whole. It has shown that there are a number of areas and issues that should be both necessary and of interest to focus on further. We need more knowledge about risks and incidents such as accidents that occur involving wheelchairs on public transport. Nor are the long-term human consequences of such accidents known in terms of both physical and mental wellbeing. Knowledge is similarly lacking with regard to the ways in which risks, incidents and accidents will affect continued mobility and travel by, for example, tram in the future. Our study shows that there is also a need for both quantitative and qualitative research regarding accidents attributable to various factors, such as electrical chair brakes, footrests that fall off, the risk of falling out of the wheelchair, tipping over on bends, or the ramp coming loose and falling down.

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Appendix 1: Photo documentation – different tram models and technologies

Picture 1. The latest tram, M33. Photo: Jörgen Lundälv

Picture 2. The latest tram, M33. Photo: Jörgen Lundälv

Picture 3. M31 tram. Photo: Jörgen Lundälv

Picture 4. M29 tram. Single car, inaccessible tram.
Photo: Per Olof Larsson

Picture 5. M31 tram, with accessible middle section. Photo: Per Olof Larsson

Picture 6. M31 tram, signal buttons for ramp. Photo: Per Olof Larsson

Picture 7. M31 tram, ramp out of order. Photo: Per Olof Larsson

Picture 8. M31 tram, with manual ramp and stairs up to high-floor section. Photo: Per Olof Larsson

Picture 9. M32 tram. Photo: Per Olof Larsson

Picture 10. M32 tram, interior. Photo: Per Olof Larsson

Picture 11. Steep walkway from stop for wheelchairs, shorter stairs for pedestrians. Photo: Per Olof Larsson

Picture 12. Three routes from the stop. A short one for pedestrians, a very steep one for, e.g. prams, and a very long one for wheelchairs. Photo: Per Olof Larsson

Pictures 13–15. Loop terminal with three stops.

Top, boarding for pedestrians, with long distance from tram floor to platform.

Middle, alighting for all.

Bottom, elevated platform and boarding for wheelchairs. Photo: Per Olof Larsson

Picture 16. Short distance between tram floor and platform on left.
Long distance between tram floor and platform on right. Photo: Per Olof Larsson

Picture 17. M33 tram with deployed ramp and retracted ramp.
The M33 urges passengers not to step on the ramp. Photo: Per Olof Larsson

Picture 18. M33 tram, wheelchair area. Photo: Robert Kindberg

Picture 19. M33 tram. Photo: Per Olof Larsson

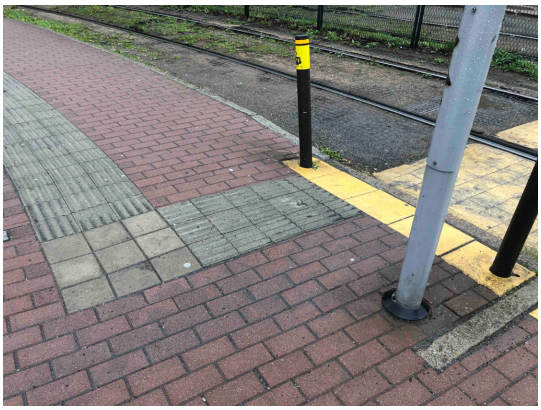
Picture 20. M33 tram, emergency brake that cannot be reached by a wheelchair user. Photo: Robert Kindberg

Picture 21. Faulty display. The right side is dark. Photo: Per Olof Larsson

Picture 22. Barriers to wheelchairs in the street environment, with level differences.Photo: Jörgen Lundälv

Picture 23. Markers for people with visual impairments and track barriers for wheelchairs. Photo: Jörgen Lundälv

Picture 24. Textured surfaces for people with visual impairments, posing an obstacle to wheelchairs. To the right side is a bevelled kerb for wheelchairs. Photo: Jörgen Lundälv



Picture 25. Textured surface and yellow markers for people with visual impairments.
Photo: Jörgen Lundälv

Picture 26. Wheelchairs, prams and cyclists have to compromise on space. Level difference up towards pavement. Photo: Jörgen Lundälv

Picture 27. Uncleaned and foul-smelling lift area. Photo: Per Olof Larsson